27. A mixture of soda-lime and sulphur consisting of polysulphides causes no change of volume in a current of helium passed over it at a bright red heat.

28. Induction sparks in an ozone apparatus passed through a mixture of helium with benzene vapour in presence of liquid benzene for many hours, gave no change of volume. The benzene was, of course, altered, but the sum of the pressures of the helium and the benzene-vapour remained as at first. Had helium been removed, contraction would have occurred.

This ends the catalogue of negative experiments. Any compound of helium capable of existence will probably be endothermic, and the two methods of producing endothermic compounds, where no simultaneous exothermic reaction is possible, are exposure to a high temperature, at which endothermic compounds show greater stability, and the influence of the silent electric discharge. These methods have been tried, so far in vain. There is, therefore, every reason to believe that the elements, helium and argon, are non-valent, that is, are incapable of forming compounds.

"On the Amount of Argon and Helium contained in the Gas from the Bath Springs."* By Lord Rayleigh, Sec. R.S. Received April 30,—Read May 21, 1896.

The presence of helium in the residue after removal of nitrogen from this gas was proved in a former paper,† but there was some doubt as to the relative proportions of argon and helium. A fresh sample, kindly collected by Dr. Richardson, has therefore been examined. Of this 2500 c.c., submitted to electric sparks in presence of oxygen, gave a final residue of 37 c.c., after removal of all gases known until recently. The spectrum of the residue, observed at atmospheric pressure, showed argon, and the D_3 line of helium very plainly.

The easy visibility of D_3 suggested the presence of helium in some such proportion as 10 per cent., and this conjecture has been confirmed by a determination of the refractivity of the mixture. It may be remembered that while the refractivity of argon approaches closely that of air, the relative number being 0·961, the refractivity of helium (as supplied to me by Professor Ramsay) is very low, being only 0·146 on the same scale. If we assume that any sample

* I am reminded by Mr. Whitaker that helium is appropriately associated with the Bath waters, which, according to some antiquaries, were called by the Romans *Aquæ Solis*.

† 'Roy. Soc. Proc.,' vol. 59, p. 206, 1896.

of gas is a mixture of these two, its refractivity will determine the proportions in which the components are present.

The observations were made by an apparatus similar in character to that already described, but designed to work with smaller quantities of gas. The space to be filled is only about 12 c.c., and if the gas be at atmospheric pressure its refractivity may be fixed to about 1/1000 part. By working at pressures below atmosphere very fair results could be arrived at with quantities of gas ordinarily reckoned at only 3 or 4 c.c.

The refractivity found for the Bath residue after desiccation was 0·896 referred to air, so that the proportional amount of helium is 8 per cent. Referred to the original volume, the proportion of helium is 1·2 parts per thousand.

"On the Changes produced in Magnetised Iron and Steels by cooling to the Temperature of Liquid Air." By JAMES DEWAR, LL.D., F.R.S., Fullerian Professor of Chemistry in the Royal Institution of Great Britain, and J. A. FLEMING, M.A., D.Sc., F.R.S., Professor of Electrical Engineering in University College, London. Received April 25,—Read May 21, 1896.

The action of the low temperature produced by liquid air upon the magnetic moment of steel magnets was studied by one of us in a few cases in a preliminary research made some time ago.* We have recently returned to the subject and made further investigations on the influence of the low temperatures thus obtained on magnetised iron and steels of very various compositions, with the object of determining the nature of the changes which take place in the magnetic moment of small magnets constructed of these metals, when cooled gradually or suddenly down to the lowest temperature obtainable by the use of boiling liquid air. The arrangements adopted in this investigation were as follows:—

A reflecting magnetometer consisting of three small magnetised needles of watch-spring steel, cemented to a concave glass mirror, suspended by a single cocoon fibre, was placed in a tube so as to be free from disturbance by draughts of air. The small magnets were 8 to 10 mm. in length. The image of a portion of the filament of an incandescent lamp was reflected by the mirror on to a divided scale placed at a distance of 70 cm. from the mirror. The edge of the very sharp image of the filament, focussed upon the scale,

* Friday evening discourse at the Royal Institution, "On the Scientific Uses of Liquid Air," by James Dewar, LL.D., F.R.S., January 19, 1894.